







QUANTA CHEMISTRY

An Institute of Chemical Sciences

DPP-(1) – PERIODIC PROPERTIES

- Among the following, the isoelectronic species are:
(I) NH_3 (II) H_2O (III) CH_3^- (IV) SF_6
(a) I and II (b) II and III (c) III and IV (d) I, II and III
- The maximum value of l for an electron in 6^{th} energy level is:
(a) 6 (b) 5 (c) 4 (d) 2
- If $n + l = 5$, which among the following subshells are possible
(a) 4s (b) 4p (c) 3d (d) Both (b) and (c)
- Which of the following electronic configuration represent most electronegative element:
(a) $[\text{He}]2s^1$ (b) $[\text{He}]2s^2sp^1$ (c) $[\text{He}]2s^2sp^5$ (d) $[\text{He}]2s^22p^3$
- The electronic configuration of three elements are –
(I) $[\text{Rn}]5f^{14} 6d^1 7s^2$ (II) $[\text{He}]2s^1$ (III) $[\text{He}]2s^2sp^5$
Consider the following statements
(i) II is an electropositive element (ii) III is an electronegative element
(iii) I is a d-block element (iv) I and III shows variable oxidation state
Which statement is true (T) or false (F)
(a) TTFT (b) TTTT (c) TTFF (d) FFTT
- When the quantum numbers n, l, m, s are represented by 4, 3, 4, $+1/2$ the symbolism for the electron is –
(a) 3d (b) 4f
(c) 4d (d) impossible set of quantum number
- Which of the following set of quantum number is correct for an electron in 4d orbital
(a) $n = 4, l = 2, m = 1, s = 1/2$
(b) $n = 4, l = 3, m = 3, s = -1/2$
(c) $n = 3, l = 3, m_s = 3, s = -1/2$
(b) $n = 4, l = 2, m = 3, s = 1/2$
- How many electrons are present in all subshells (fully filled) with $(n + l) = 5$
(a) 6 (b) 16 (c) 18 (d) 2

9. For the quantum numbers n, l, m and s having values 3, 2, 1, $+1/2$ represent the electron is present in –
 (a) 4s (b) 3d (c) 3p (d) 3s
10. Which among the following is not in accordance with aufbau's principle –
 (a) $5f < 6d < 7s < 7p$ (b) $7s < 5f < 6d < 7p$
 (c) $3d < 4p < 5s < 4d$ (d) $6s < 4f < 5d < 6p$
11. Which of the following have same number of electrons in their outermost subshell –
 (a) Li and He (b) O^{2-} and N^{2-} (c) F^- and N^{3-} (d) Na^+ and Mg^+
12. If each orbital can hold maximum of three electrons, the number of elements in 11th period are –
 (a) 36 (b) 72 (c) 86 (d) 108
13. According to Hund's rule, which among the following will be correct representation for ground state of nitrogen –
 (a)  (b)  (c)  (d) 
14. What are the possible values for n, l and m quantum number for 5f orbitals –
 (a) $n = 5, l = 3, m = -4$ (b) $n = 5, l = 3, m = +4$
 (c) $n = 5, l = 2, m = -2$ (d) $n = 5, l = 3, m = -2$
15. Identify the element that has ground state configuration $[Ar]4s^2 3d^3$
 (a) Aluminium (b) Vanadium (c) Gallium (d) Titanium

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DPP-(1) – PERIODIC PROPERTIES

ANSWER KEY

- | | | |
|------|-------|-------|
| 1. d | 7. a | 13. b |
| 2. b | 8. c | 14. d |
| 3. d | 9. b | 15. b |
| 4. c | 10. a | |
| 5. c | 11. c | |
| 6. d | 12. d | |

HINTS & SOLUTIONS

- d
- Isoelectronic species have same number of electrons.
 NH_3 , H_2O and CH_3^- have $10 e^-$ each hence isoelectronic
- b
- Maximum value of l for $n = 6$ is 5,
because, for any given value of n , l varies from zero to $(n - 1)$.
- d
- If $n + l = 5$
$$\begin{array}{ll} n = 3 & n = 4 \\ \text{then, } l = 2 \Rightarrow 3d \text{ subshell} & \text{and } l = 1 \Rightarrow 4p \text{ subshell} \end{array}$$
- c
- Most electronegative element is fluorine and its electronic configuration is $[\text{He}]2s^2 2p^5$.
- c
- II is lithium \Rightarrow an electropositive element
III is fluorine \Rightarrow an electronegative element
I is a f-block element

III do not shows variable oxidation state

6. d

6. if $n = 4$

l can be $\Rightarrow 0, 1, 2, 3$

and m_l can be $\Rightarrow -3, -2, -1, 0, +1, +2, +3$

M_s or s can be $\Rightarrow +1/2$ or $-1/2$

7. a

7. for 4d orbital, $n = 4$ and $l = 2$

$m = -2, -1, 0, +1, +2$ and $s = +1/2$ or $-1/2$

8. c

8. $(n + l) = 5$

Possible subshells are $5s, 4p$ and $3d$

No. of e^- in $5s = 2$

No. of e^- in $4p = 6$

Number of electron in $3d = 10$

\therefore Total $e^- = 10 + 6 + 2 = 18e^-$

9. b

9. for $n = 3$ and $l = 2$

the e^- must be present in $3d$ orbital.

10. a

10. According to aufbau's principle.

$$7s < 5f < 6d < 7p$$

Hence incorrect energy order is $5f < 6d < 7s < 7p$

11. c

11. F^- have $1s^2 2s^2 2p^6 \Rightarrow 6$ electrons in outermost subshell

N^{3-} have $1s^2 2s^2 2p^6 \Rightarrow 6$ electrons in outermost subshell

$Li \Rightarrow 1s^2 2s^1 \Rightarrow 1e^-$ in outermost subshell

$He \Rightarrow 1s^2 \Rightarrow 2e^-$ in outermost subshell

$Na^+ \Rightarrow 1s^2 2s^2 2p^6 \Rightarrow 6e^-$ in outermost subshell

$Mg^+ \Rightarrow 1s^2 2s^2 2p^6 3s^1 \Rightarrow 1e^-$ in outermost subshell

12. d

12. Number of orbitals in n^{th} period ($n = \text{odd}$)

$$= \left(\frac{n+1}{2} \right)^2$$

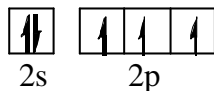
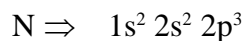
$$\therefore \text{number of orbitals in } 11^{th} \text{ period} = \left(\frac{11+1}{2} \right)^2 = 36$$

Each orbital can hold maximum $3e^-$

\therefore Maximum number of e^- or elements in 11th period = $36 \times 3 = 108$

13. b

13. That configuration which have maximum value for spin multiplicity will be the ground state.



$$s = \left| \left(+\frac{1}{2} + \frac{1}{2} + \frac{1}{2} \right) \right| = \frac{3}{2}$$

$$S_m = 2s + 1 = 2 \times \frac{3}{2} + 1 = 4$$

14. d

14. for 5d orbitals

$$n = 5, l = 3$$

Possible m values can be from -3 to +3 $\Rightarrow -3, -2, -1, 0, +1, +2, +3$

$$\therefore n = 5, l = 3, m = -2$$

15. b

15. [Ar] $4s^2 3d^3$ is vanadium

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DPP-(2) – PERIODIC PROPERTIES

- An element has the electronic configuration $[\text{Kr}]5s^1$. to which block and group it belongs –
(a) s-block, group 2 (b) s-block, group 1 (c) p-block, group 3 (d) p-block, group 1
- For the following configurations, predict their blocks:
(I) $[\text{Ar}]3d^54s^2$ (II) $[\text{Ar}]3d^{10}4s^24p^2$ (III) $[\text{Ar}]3d^14s^2$
(a) s, p and d respectively (b) d, p and s respectively
(c) d, p and d respectively (d) d, s and p respectively
- For an element X, the set of quantum is (n, l, m, s) equals to (3, 2, +1, +1/2) respectively, to which period does the element x belongs –
(a) 3rd period (b) 2nd period (c) 4th period (d) 5th period
- The electronic configuration of an element is $1s^2 2s^2 2p^6 3s^2 3p^5$. The atomic number and group number of the element just above the given element in the periodic table are respectively –
(a) 10 and 16 (b) 9 and 17 (c) 9 and 15 (d) 9 and 16
- Effective nuclear charge ($Z_{\text{eff}} = Z - \sigma$), in this formula what is 'σ' and which rule is used in its calculation –
(a) Screening constant, Hund's rule (b) Repulsion constant, (n + l) rule
(c) Screening constant, Slater's rule (d) Screening constant, Aufbau's principle
- What is the effective nuclear charge experienced by last electron of sodium atom?
(a) 8.8 (b) 11 (c) 18.8 (d) 2.2
- Which among the following statements is correct –
(a) Effective nuclear charge increases down the group
(b) Effective nuclear charge decreases from left to right in a period.
(c) Effective nuclear charge increases from left to right in a period.
(d) Effective nuclear charge constant down the group.
- For an element having electronic configuration $[\text{Kr}]5s^1 4d^5$ belongs to which block and group respectively –
(a) s-block, group 1 (b) d-block, group 6
(c) d-block, group 5 (d) s-block, group 2

9. Using Slater's rule, what would be the shielding constant for a 3d electron from the configuration $1s^2 2s^2 2p^6 3s^6 4s^2 3d^8$ –
 (a) 7.55 (b) 18.00 (c) 28.00 (d) 20.45
10. Consider the following –
Assertion: 4s electron is less tightly held than the 3d electron.
Reason: Effective nuclear charge for 4s is considerably smaller than that of 3d electron.
 Which of the following is correct option:
 (a) Assertion is correct but reason is not correct
 (b) Assertion and reason both are correct
 (c) Assertion and reason both are incorrect
 (d) Assertion and incorrect but reason is correct.
11. Which type of electron is more likely to be lost when copper forms positive ion –
 (a) 3d
 (b) 4s
 (c) loss from 4s and 3d both are equally probable
 (d) Cannot be predicted
12. To which the lanthanides belongs –
 (a) Group 7 (b) Group 8 (c) Group 6 (d) Group 3
13. The correct values for Z_{eff} for Sc, Ti and V (considering σ for last s electron) respectively are –
 (a) 3.15, 3.0, 3.3 (b) 3.3, 3.15, 3.0 (c) 3.0, 3.15, 3.3 (d) 3.0, 3.3, 3.15
14. For the given configuration predict the block, group number & period number –
 $[\text{Ar}]4s^2 3d^{10} 4p^5$
 (a) d, 7, 4 respectively (b) p, 17, 4 respectively
 (c) s, 5, 4 respectively (d) p, 5, 4 respectively
15. The effective nuclear charge experienced by the electron on periphery of nitrogen atom –
 (a) 3.55 (b) 3.45 (c) 3.90 (d) 3.10

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DPP-(1) – PERIODIC PROPERTIES

ANSWER KEY

- | | | |
|------|-------|---------|
| 1. b | 7. c | 13. c |
| 2. c | 8. b | 14. b |
| 3. a | 9. d | 15. (a) |
| 4. b | 10. b | |
| 5. c | 11. b | |
| 6. d | 12. d | |

HINTS & SOLUTIONS

- b
- Electronic configuration is $[\text{Kr}]5s^1$. Last e^- enters in s-subshell so it is a s-block element and group number for s-block $\Rightarrow x$ for ns^x configuration.
- c
- (I) \Rightarrow Chromium \rightarrow d-block
(II) \Rightarrow Gallium \rightarrow p-block
(III) \Rightarrow Scandium \rightarrow d-block
- a
- The value of 'n' (principle quantum no.) gives information about the period of element.
- b
- From configuration it is clear that element belongs to p-block because last e^- enters in p-subshell.
 \therefore Group number for p-block = $12 + x$
($x \rightarrow$ no. of e^- present in np^x)
Hence, element present just above the given element will also be a p-block element \Rightarrow group number = $12 + 5 = 17$
and atomic number = 9 ($1s^2 2s^2 2p^5$)

5. c

5. $Z_{\text{eff}} = Z - \sigma$ (Screening constant and is calculated using Slater's rule).

6. d

6. $\text{Na} \Rightarrow 1s^2 / 2s^2 2p^6 / 3s^2$ last e^- is present in s-subshell

$$\sigma = (0.35 \times 0) + (0.85 \times 8) + (2 \times 1) = 8.8$$

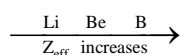
$$Z_{\text{eff}} = Z - \sigma$$

$$= 11 - 8.8$$

$$Z_{\text{eff}} = 2.2$$

7. c

7. On moving across a period (left to right) effective nuclear charge increases



8. b

8. As the last e^- is entering in d-subshell, it is a d-block element.The group number for d-block elements = $x + y$ where $x \Rightarrow$ number of e^- present in ns^x $y \Rightarrow$ number of e^- present in $(n-1)d^y$

$$\therefore 5 + 1 = 6 \text{ group}$$

9. d

9. $1s^2 / 2s^2 2p^6 / 3s^2 3p^6 3d^8 / 4s^2$

$$\sigma = (0.35 \times 7) + (18 \times 1)$$

$$\sigma = 2.45 + 18.00 = 20.45$$

10. b

Effective nuclear charge

4s electron	$<$	3d electron
↓		↓
4.05		7.55

Because of less Z_{eff} , 4s electron is held less tightly than 3d electron.

11. b

11. Although 4s is filled prior to 3d while filling electrons but Z_{eff} experienced by 4s electrons is considerably smaller than 3d e^- hence 4s e^- are held less tightly so e^- will be lost from 4s orbitals.

12. d

12. Lanthanoids have last e^- in f-subshell

Group 3

Sc

Y

La

Group 4

Ti

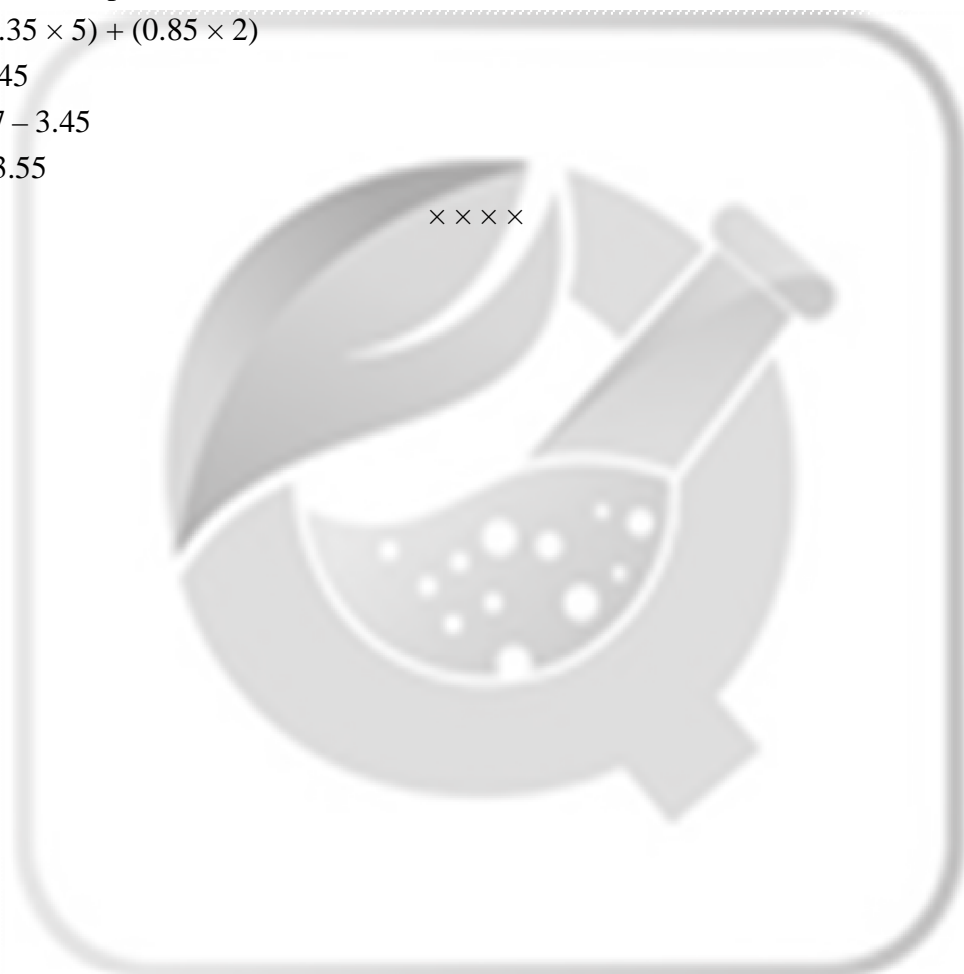
Zr

Hf

\longleftrightarrow
 atomic no. 58-71 \Rightarrow 14 f-block element

 \therefore All f-block elements belong to group 3.

13. c
13. Z_{eff} for 3d series and last electron (s-subshell)
 $Z_{\text{eff}} = 2.85 + 0.15 n$
 Also, on moving from left to right Z_{eff} increases.
14. b
14. The given configuration belongs to element Bromine.
 p-block element
 Group number = 12 + number of e^- in $np = 12 + 5 = 17$
 Period number = highest value of n
15. (a)
15. For calculation of Z_{eff} on periphery, all electrons are counted.
 $N \Rightarrow 1s^2 / 2s^2 2p^3$
 $\sigma = (0.35 \times 5) + (0.85 \times 2)$
 $\sigma = 3.45$
 $Z_{\text{eff}} = 7 - 3.45$
 $Z_{\text{eff.}} = 3.55$





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DPP-(3) – PERIODIC PROPERTIES

- Which among the following statements is correct –
(a) the radius of a single atom can be called covalent radius
(b) the radius is calculated in bonded state
(c) electrons move only in circular motion.
(d) distance between inner electron and last electron is called atomic radius
- In terms of distance, which of the following order is correct –
(r_{VR} – vanderwaal radius, r_M – metallic radius, r_C – covalent radius)
(a) $r_{VR} < r_M < r_C$ (b) $r_{VR} < r_C < r_M$ (c) $r_C < r_M < r_{VR}$ (d) $r_M < r_C < r_{VR}$
- Considering metallic bonding, which of the following statement is incorrect –
(a) It is calculated for metals in solid state
(b) Metallic radii do not depend on the of packing
(c) Metallic radii is smaller than covalent radius
(d) Metallic radii is amaller then vanderwaal's radii
- The correct order of radii is:
(a) $C < O < F$ (b) $O < C < F$ (c) $F < O < C$ (d) $O < F < C$
- Predict the correct statement among the following –
(a) radii of helium is less than hydrogen
(b) radii of helium and hydrogen are compound
(c) radii of helium and hydrogen are exactly same
(d) radii of helium is greater than that of hydrogen
- Incorrect order of size among the following option is –
(a) $Na > Mg > Al > Ar$ (b) $Li > Be > B > C$
(c) $C > N > O > F$ (d) $Ne > Li > Be > B$
- Incorrect order of radii among the following is –
(a) $Ca < Sr < Ra < Ba$ (b) $Li < Na < K < Rb$
(c) $Be > Mg > Ca > Sr$ (d) $K < Rb < Cs < Fr$

8. Consider the following –
 Statement I : Size of 4d series is very close to that of 5d series elements.
 Statement II : Down the group, Z_{eff} decreases hence radii increases
 Which among the following statement is correct –
 (a) Statement I and II both are correct & II is correct explanation for I
 (b) Statement I and II both are correct but II is not correct explanation for I.
 (c) Statement I and II both are incorrect
 (d) Statement II is correct but statement I is incorrect.
9. The correct order of radii is –
 (a) $N > Be > B$ (b) $F^- < O^{2-} < N^{3-}$ (c) $Na < Li < K$ (d) $Fe^{3+} < Fe^{2+} < Fe^{4+}$
10. Which of the following options represents correct trend of size
 (a) $Mg > Mg^{2+} > Mg^{+1}$ (b) $Mg > Mg^{+1} > Mg^{2+}$
 (c) $Mg^{+1} > Mg^{2+} > Mg$ (d) $Mg^{2+} > Mg^{+1} > Mg$
11. For the given species, which option predicts correct order of their size:
 (a) $N^{3-} > O^{2-} > F^-$ (b) $F^- > Ne > Na^+$
 (c) $Na^+ > Mg^{2+} > Al^{3+}$ (d) Both (a) and (b)
12. The correct order of size of S, S^{2-} , S^{2+} , S^{4+} species is –
 (a) $S > S^{2+} > S^{4+} > S^{2-}$ (b) $S^{2+} > S^{4+} > S^{2-} > S$
 (c) $S^{2-} > S > S^{2+} > S^{4+}$ (d) $S^{4+} > S^{2-} > S > S^{2+}$
13. In which of the following option decreasing ionic size is correctly –
 (a) $O^{2-} > S^{2-} > Se^{2-} > Te^{2-}$ (b) $Te^{2-} > Se^{2-} > S^{2-} > O^{2-}$
 (c) $Se^{2-} > S^{2-} > Te^{2-} > O^{2-}$ (d) $S^{2-} > Te^{2-} > Se^{2-} > O^{2-}$
14. Among the following which option is incorrect regarding size –
 (a) $B > Al > Ga > In$ (b) $C < Si < Ge < Sn$
 (c) $B < Ga < Al < In$ (d) $Na < K < Rb < Cs$
15. Which of the following statement is correct regarding vanderwaal radii –
 (a) it is measured for alkali metals
 (b) it is measured for d-block elements
 (c) defined for atoms having strong intermolecular force between them.
 (d) defined for atoms which don't have force of attraction.

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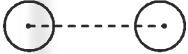


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DPP-(3) – PERIODIC PROPERTIES

ANSWER KEY

- | | | |
|------|-------|-------|
| 1. b | 7. d | 13. b |
| 2. c | 8. b | 14. a |
| 3. c | 9. b | 15. d |
| 4. c | 10. b | |
| 5. d | 11. d | |
| 6. a | 12. c | |

HINTS & SOLUTIONS

- b
1. Since atom is very small in size and electrons also have wave like nature so radius is always calculated in bonded state.
- c
2. $r_{VR} \Rightarrow$  $r_M \Rightarrow$  $r_M \Rightarrow$ 
- c
3. Metallic radii calculated for metals in solid state and do not depend on type of packing
 $r_M > r_C$ and $r_M < r_{VR}$
- c
4. On going from left to right, Z_{eff} increases hence atomic radii decreases
 \therefore Correct order $\Rightarrow F < O < C$
- d
5. Although on going from left to right radii decreases but here, radii of $He > H$ because for He, vanderwaal radius would be defined and for that of H, covalent radius. And vanderwaal radii $>$ covalent radii.
- a
6. Noble gases have highest radii in their respective periods.

7. d
7. Incorrect order $\Rightarrow K < Rb < Cs < Fr$
Size of 6th period elements is greater than 7th period elements because of relativistic effect.
8. b
8. Statement I and II both are correct. But the reason for almost similar radii of 4d and 5d elements is lanthanide contraction.
9. b
9. $\xrightarrow[\text{ionic radii increases}]{F^- < O^{2-} < N^{3-}}$
10. b
10. size comparison
- $\xrightarrow[\text{size decreases because } Z_{\text{eff.}} \uparrow]{A > A^{+1} > A^{+2}}$
 $\therefore \text{Size of } Mg > Mg^{+1} > Mg^{2+}$
11. d
11. $\xrightarrow[\text{No. of protons } \uparrow, Z_{\text{eff.}} \uparrow, \text{size } \downarrow]{N^{3-} \ O^{2-} \ F^- \ Ne \ Na^+ \ Mg^{2+} \ Al^{3+}}$ (all of these are isoelectronic species (10 e⁻))
12. c
12. Size of anion > size of parent atom > size of cations of parent atom
13. b
13. As O, Se, S, Te belongs to same group.
- $\xrightarrow[\text{size increases}]{O^{2-} < S^{2-} < Se^{2-} < Te^{2-}}$
14. a
14. Because of d – contraction or scandide contraction, size of Ga < Al. After ten d-block elements, comes Ga and because of poor shielding by d-orbitals, $Z_{\text{eff.}}$ increases hence size decreases.
15. d
15. Vanderwaal radii is defined for atoms that do not have forces of attraction.

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DPP-(4) – PERIODIC PROPERTIES

- The ionization energy of Boron is less than that of Beryllium because—
 - beryllium has higher nuclear charge than boron
 - beryllium has a lower nuclear charge than boron
 - the outermost electron in boron occupies a 2p-orbital
 - the 2s and 2p-orbitals of boron are degenerate
- Amongst the following, the highest ionization energy is—

(a) [Ne] 3s ² 3p ²	(b) [Ne] 3s ² 3p ³
(c) [Ne] 3s ² 3p ⁵	(d) [Ne] 3s ² 3p ¹
- The ionization potential of Li & K are 5.4 and 4.3 eV respectively. The ionization potential of Na will be—

(a) 9.7 eV	(b) 9.1 eV
(c) 4.9 eV	(d) cannot be calculated
- Element having highest ionization potential is—

(a) Ar	(b) He
(c) Be	(d) N
- For which of the following reaction ΔH° value is equal to the first ionization energy of Mg—

(a) $\text{Mg}_{(g)}^+ \longrightarrow \text{Mg}_{(g)}^{2+} + e^-$	(b) $\text{Mg}_{(g)} \longrightarrow \text{Mg}_{(g)}^{2+} + 2e^-$
(c) $\text{Mg}_{(g)} \longrightarrow \text{Mg}_{(g)}^{1+} + e^-$	(d) $\text{Mg}_{(s)} \longrightarrow \text{Mg}_{(g)}^{2+} + e^-$
- The amount of energy released on addition of an electron in outermost shell of an isolated atom is called—

(a) Electronegativity	(b) Ionization energy
(c) Hydration energy	(d) Electron gain enthalpy
- The increasing order of electron affinity for the following electronic configurations of element is—

(I) 1s ² 2s ² 2p ⁶ 3s ² 3p ⁵	(II) 1s ² 2s ² 2p ⁵
(III) 1s ² 2s ² 2p ⁶ 3s ¹	(IV) 1s ² 2s ² 2p ³
(a) I > II > IV > III	

- (b) $\text{III} > \text{II} > \text{I} > \text{IV}$
 (c) $\text{IV} > \text{II} > \text{I} > \text{III}$
 (d) $\text{I} > \text{II} > \text{III} > \text{IV}$
8. The process requiring absorption of energy is—
 (a) $\text{N} \longrightarrow \text{N}^-$ (b) $\text{Cl} \longrightarrow \text{Cl}^-$
 (c) $\text{H} \longrightarrow \text{H}^-$ (d) $\text{Br} \longrightarrow \text{Br}^-$
9. Arrange N, O & S in order of decreasing electron affinity—
 (a) $\text{N} > \text{O} > \text{S}$ (b) $\text{S} > \text{O} > \text{N}$
 (c) $\text{O} > \text{S} > \text{N}$ (d) $\text{S} > \text{N} > \text{O}$
10. Which of the following process involves absorption of energy—
 (a) $\text{S}_{(\text{g})} + \text{e}^- \longrightarrow \text{S}_{(\text{g})}^-$ (b) $\text{S}_{(\text{g})}^- + \text{e}^- \longrightarrow \text{S}_{(\text{g})}^{2-}$
 (c) $\text{S}_{(\text{g})} \longrightarrow \text{S}_{(\text{g})}^+ + \text{e}^-$ (d) Both (b) & (c)
11. The electronegativity of following elements—
 (a) $\text{F} > \text{O} > \text{Cl} > \text{N}^-$ (b) $\text{F} > \text{O} > \text{N} > \text{Cl}$
 (c) $\text{F} > \text{Cl} > \text{O} > \text{N}$ (d) $\text{F} > \text{N} > \text{O} > \text{Cl}$
12. The expression of “All red - Rochow scale” is—
 (a) $\chi_{\text{AR}} = \frac{0.359 Z_{\text{eff.}}}{r^2} + 0.744$ (b) $\chi_{\text{AR}} = \frac{0.359 Z_{\text{eff.}}}{r} + 0.744$
 (c) $\chi_{\text{AR}} = \frac{0.359 r^2}{Z_{\text{eff.}}} + 0.744$ (d) $\chi_{\text{AR}} = \frac{0.359}{Z_{\text{eff.}}} + 0.744$
13. Which among the following scales gives relative value of electronegativity—
 (a) Mulliken scale (b) Allred-Rochow scale
 (c) Pauling scale (d) None of these
14. Which of the following statements is correct—
 (a) Electronegativity represented on Pauling scale is greater than Mulliken scale
 (b) Electronegativity represented on Mulliken scale is greater than Pauling scale
 (c) Both pauling & Mulliken scale have equal electronegativity values
 (d) cannot be compared
15. The correct order of electronegativity of underlined atoms is—
 (a) $\text{H}_2\text{O} > \text{C} \equiv \underline{\text{N}} > \text{H}_2\underline{\text{C}} = \text{CH}_2$ (b) $\text{H}_2\text{O} > \text{H}_2\underline{\text{C}} = \text{CH}_2 > \text{C} \equiv \underline{\text{N}}$
 (c) $\text{C} \equiv \underline{\text{N}} > \text{H}_2\text{O} > \text{H}_2\underline{\text{C}} = \text{CH}_2$ (d) $\text{H}_2\underline{\text{C}} = \text{CH}_2 > \text{C} \equiv \underline{\text{N}} > \text{H}_2\text{O}$

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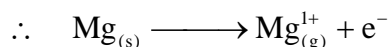
DPP-(4) – PERIODIC PROPERTIES

ANSWER KEY

- | | | |
|--------|---------|---------|
| 1. (c) | 7. (d) | 13. (c) |
| 2. (b) | 8. (a) | 14. (b) |
| 3. (c) | 9. (b) | 15. (c) |
| 4. (b) | 10. (d) | |
| 5. (c) | 11. (a) | |
| 6. (d) | 12. (a) | |

HINTS & SOLUTIONS

- (c)
- This is because the outermost electron in boron is present in 2p-orbital whereas that of Be is present in 2s-orbital. Hence, I.E. (Be) > I.E. (B).
- (b)
- Exactly half filled or completely filled configuration have high I.E. as compared to other configuration.
 $P \rightarrow [Ne] 3s^2 3p^3 \Rightarrow$ exactly half filled configuration.
- (c)
- On descending the group, ionization energy decreases. So ionization energy of Na should be something intermediate b/w that of Li & K ionization energy.
- (b)
- He being a noble gas (completely filled configuration) & smallest in size among the given options.
- (c)
- Ionization energy is defined as the energy required to remove the loosely bound electron from isolated gaseous atom.



6. (d)
6. electron gain enthalpy is the amount of energy released on addition of electron in outermost shell of isolated gaseous atom.
7. (d)
7. • $1s^2 2s^2 2p^6 3s^2 3p^5 \Rightarrow$ being one-short in completely filled configuration also 3p subshell are not to small to accomodate an extra incoming electron.
- $1s^2 2s^2 2p^3 \Rightarrow$ configuration is exactly half filled to donot want to accomodate an extra electron.
8. (a)
8. N being exactly half filled electronic configuration would not accept the incoming electron easily hence energy is to be supplied for this addition of e^- .
9. (b)
9. • S being larger in size than O & N accepts incoming electron easily in comparatively larger 3p orbital.
- Among N & O, N have exactly half filled configuration so it don't accept the e^- easily. $N \rightarrow N^-$ is an endothermic process.
10. (d)
10. Ionization energy and second electron gain enthalpy, both are endothermic processes.
11. (a)
11. Accordingly to pauling scale—
- | | | | | |
|--------------------|------|------|------|------|
| | F | O | Cl | N |
| $\chi \Rightarrow$ | 3.98 | 3.44 | 3.16 | 3.04 |
12. (a)
12. Correct formula is $\chi_{AR} = \frac{0.359 Z_{eff.}}{r^2} + 0.744$
13. (c)
13. In pauling scale, electronegativity is calculated w.r.t. F, it is a relative scale.
14. (b)
14. $\chi_{Mulliken} = \chi_{Pauling} \times 2.8$
15. (c)
15. Electronegativity of $N_{(sp)} > O_{(sp^3)} > C_{(sp^2)}$

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Assignment Sheet - Periodic Properties

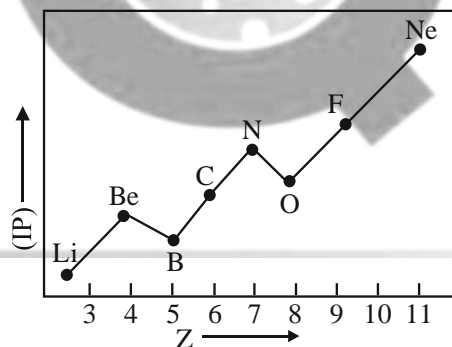
- The first, second and third ionization energies (E_1 , E_2 and E_3) for an element are 7eV, 12.5 eV and 42.5 eV respectively. The most stable oxidation state of an element will be –
(a) + 1 (b) + 4 (c) + 3 (d) + 2
- The ionization energy will be higher when the electron is removed from –
(a) s-orbital (b) p-orbital (c) d-orbital (d) f-orbital
- Second ionization potential of Li, Be and B is in the order –
(a) $\text{Li} > \text{Be} > \text{B}$ (b) $\text{Li} > \text{B} > \text{Be}$ (c) $\text{Be} < \text{B} < \text{Li}$ (d) $\text{B} > \text{Li} > \text{Be}$
- Which of the following metal is expected to have highest third ionization energy?
(a) Cr ($Z = 24$) (b) Fe ($Z = 26$) (c) Mn ($Z = 25$) (d) Co ($Z = 27$)
- The second ionization potential of elements is invariably higher than first ionization potential because –
(a) ionization is an endothermic process
(b) size of cation is smaller than its atom so more hold on electrons.
(c) it is easier to remove electron from cation
(d) None of these
- The correct order of ionization energy is :
(a) $M_{(g)}^{2+} < M_{(g)}^+ < M_{(g)}$ (b) $M_{(g)}^+ < M_{(g)}^{2+} < M_{(g)}$
(c) $M_{(g)} < M_{(g)}^{2+} < M_{(g)}^+$ (d) $M_{(g)} < M_{(g)}^+ < M_{(g)}^{2+}$
- In the following configuration a sudden large gap between the values of second and third ionization energies of an element?
(a) $1s^2 2s^2 2p^6 3s^2 3p^3$ (b) $1s^2 2s^2 2p^3$
(c) $1s^2 2s^2 2p^6 3s^2 3p^1$ (d) $1s^2 2s^2 2p^6 3s^2$
- Amongst the following, incorrect order is –
(a) $\text{IE}_1(\text{Be}) > \text{IE}_1(\text{B})$ (b) $\text{IE}_2(\text{Na}) > \text{IE}_2(\text{Mg})$
(c) $\text{IE}_3(\text{Mg}) > \text{IE}_3(\text{Be})$ (d) $\text{IE}_1(\text{N}) > \text{IE}_1(\text{O})$

9. Among the following, the correct trend of ionization energy (IE_1) is –
 (a) $Cl > P > S$ (b) $P > Cl > S$ (c) $P > S > Cl$ (d) $Cl > S > P$
10. Which of the following statements are correct –
 (a) If IE and EA are high, the element would be highly electronegative
 (b) If IE and EA are high, the element would be electropositive
 (c) If IE and EA are low, the element would be electronegative
 (d) None of these
11. The electronegativity values of Mulliken Scale –
 (a) absolute value of electronegativity
 (b) higher than pauling scale values
 (c) relative value of electronegativity
 (d) both (a) and (b)
12. Nitrogen has very low electron affinity because –
 (a) Low electron repulsion in 2p subshell
 (b) High electron repulsion in 2p subshell
 (c) large Z_{eff} of nitrogen
 (d) 2p-subshell can accomodate only 3 electrons
13. Second electron gain enthalpy.
 (a) is always positive
 (b) always negative
 (c) can be positive or negative
 (d) is always zero
14. The second electron gain enthalpies (in $\text{kJ} / \text{mol}^{-1}$) of oxygen sulphur respectively are –
 (a) $-780, +590$ (b) $-590, +780$ (c) $+590, +780$ (d) $+780, +590$
15. The correct electron affinity is –
 (a) $Ne < Be < Li$ (b) $Be < Ne < Li$ (c) $Li < Be < Ne$ (d) $Be < Li < Ni$
16. The second ionization energy is maximum for –
 (a) nitrogen (b) oxygen (c) fluorine (d) carbon
17. The correct order of extent of hydration among the following –
 (a) $Li^+ < Na^+ < K^+ < Rb^+$ (b) $Li^+ < K^+ < Na^+ < Rb^+$
 (c) $Li^+ > Na^+ > K^+ > Rb^+$ (d) $Li^+ > K^+ > Na^+ > Rb^+$
18. Among the elements Zn, Ga, Ge and As, the one with the lowest first ionization energy is –
 (a) As (b) Zn (c) Ge (d) Ga
19. Which has maximum polarizing power of cation: –
 (a) K^+ (b) Mg^{2+} (c) Al^{3+} (d) F^-
20. Electron affinity is endothermic when –
 (a) O^+ is formed from O (b) $Na^+ + e^- \rightarrow Na$
 (c) Cl^- is formed from Cl (d) O^{2-} is formed from O

21. If the ionization energy of hydrogen atom is 13.6 eV, the expected third ionization energy of lithium atom is –
 (a) $13.6 \times 3 \text{ eV}$ (b) $13.6 \times 2 \text{ eV}$ (c) $13.6 \times 6 \text{ eV}$ (d) $13.6 \times 9 \text{ eV}$
22. Select the order of radii –
 (a) $\text{O}^{2-} > \text{F}^- > \text{Na}^+ > \text{Mg}^{2+}$ (b) $\text{Mg}^{2+} > \text{Na}^+ > \text{F}^- > \text{O}^{2-}$
 (c) $\text{F}^- > \text{O}^{2-} > \text{Mg}^{2+} > \text{Na}^+$ (d) $\text{Na}^+ > \text{F}^- > \text{Mg}^{2+} > \text{O}^{2-}$
23. Which terms are endothermic for formation of KCl –
 (I) $\text{K}_{(\text{g})} \rightarrow \text{K}_{(\text{g})}^+ + \text{e}^-$ (II) $\text{Cl}_{(\text{g})} + \text{e}^- \rightarrow \text{Cl}_{(\text{g})}^-$
 (III) $\text{K}_{(\text{g})}^+ + \text{Cl}_{(\text{g})}^- \rightarrow \text{KCl}_{(\text{s})}$
 (a) II & III (b) I only (c) II only (d) I and (III)
24. Which set of following orbitals is listed in sequential order of filling in many electron atom?
 (a) 3d, 4s, 4p (b) 6s, 4f, 5d (c) 4p, 4d, 5s (d) 3s, 3d, 3p
25. Pauling's electronegativity scale is based on calculation of –
 (a) bond energies
 (b) average of electron affinity and ionization energy
 (c) electrostatic attraction
 (d) electron densities of atoms
26. The effective nuclear charge (Z^*) for the 1s electron of zinc according to Slater's rule is nearly –
 (a) 29.65 (b) 30 (c) 29.70 (d) 20.85
27. This first ionization energy is lowest for –
 (a) Br (b) Se (c) P (d) As
28. The degree of hydration is expected to be maximum for –
 (a) Be^{2+} (b) Mg^{2+} (c) Ca^{2+} (d) Sr^{2+}
29. The electronegativity of following elements increases in the order –
 (a) S, Cl, P, Ar (b) P, S, Cl, Ar (c) F, O, N, C (d) Si, Al, Cl, Ar
30. The size of isoelectronic species O^{2-} , Ne, Mg^{2+} is affected by –
 (a) Principle quantum number (b) Size remains same
 (c) Charge on species (d) None of these
31. The dominant factor in determining the IE of the elements on moving down the groups is its
 (a) atomic radius (b) effective nuclear charge
 (c) Both (a) and (b) (d) None of the above
32. Which pair represents incorrect first (IE)?
 (a) $\text{Li} > \text{Na}$ (b) $\text{Be} > \text{B}$ (c) $\text{N} > \text{O}$ (d) $\text{He} > \text{He}^+$
33. Which has maximum IE?
 (a) Mg (b) Mg^+ (c) Mg^{2+} (d) Equal
34. SI unit of IE is
 (a) J mol^{-1} (b) kJ mol^{-1} (c) kcal mol^{-1} (d) eV atom^{-1}

35. Select the correct statement about radius of an atom.
- (a) The metallic radii are smaller than the van der Waal's radii, since the bonding forces in the metallic crystal lattice are much stronger than the van der Waal's forces
 - (b) Values of van der Waal's radii are larger than those of covalent radii and are weaker than the forces operating between atoms in covalently bonding molecule.
 - (c) Both (a) and (b) are correct
 - (d) None of the above is correct.
36. In which case bond length is shortened?
- (a) When electronegativities are different
 - (b) When multiplicity occurs between atoms
 - (c) In both cases
 - (d) In none of the cases
37. State, which one of the following has the largest atomic radius?
- (a) Ba
 - (b) Mg
 - (c) Cr
 - (d) Cs
38. Screening effect is not observed in
- (a) He^+
 - (b) Li^{2+}
 - (c) Be^{3+}
 - (d) In all cases
39. The relative extent to which the various orbitals penetrate the electron clouds of other orbitals is
- (a) $s > p > d > f$
 - (b) $s < p < d < f$
 - (c) $s > p > f > d$
 - (d) $d < s < f < p$
40. Which group of elements is analogous to the lanthanides?
- (a) Actinides
 - (b) Halides
 - (c) Borides
 - (d) Chalcogenides
41. Of the following pairs, the one containing examples of metalloid elements in the Periodic Table is
- (a) Na and K
 - (b) B and Si
 - (c) F and Cl
 - (d) Cu and Ag
42. Recently discovered elements (August 2003) with atomic number 113 and 115 have valence electrons in
- (a) s-orbital
 - (b) p-orbital
 - (c) d-orbital
 - (d) f-orbital
43. Most stable cation of element 113 will be
- (a) M^+
 - (b) M^{2+}
 - (c) M^{3+}
 - (d) M^{5+}
44. Numbering of groups as 1, 2, 18 was adopted by IUPAC in
- (a) 1906
 - (b) 1908
 - (c) 1986
 - (d) 1988
45. Element 113 is produced via
- (a) α -decay of elements-115
 - (b) α -decay of element-111
 - (c) β -decay of element-112
 - (d) β -decay of element 114
46. Recently (in August 2003) two new elements have been discovered with atomic numbers
- (a) 113, 114
 - (b) 113, 115
 - (c) 114, 115
 - (d) 115, 116
47. Recently (in 2003) element with atomic number 110 has been named by IUPAC as
- (a) Mt
 - (b) Sg
 - (c) Hs
 - (d) Ds
48. Which of the following does not represent the correct order of the properties indicated?
- (a) $\text{Sc} < \text{Ti} < \text{Cr} < \text{Mn}$ (size)

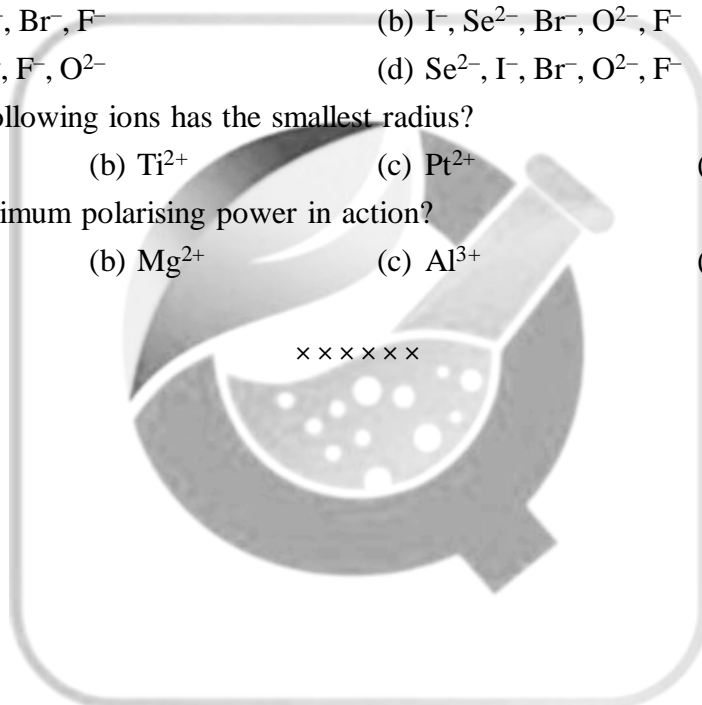
- (b) $\text{Ni}^{2+} > \text{Cr}^{2+} > \text{Fe}^{2+} > \text{Mn}^{2+}$ (size)
 (c) $\text{Ni}^{2+} < \text{Co}^{2+} < \text{Fe}^{2+} < \text{Mn}^{2+}$ (unpaired electrons)
 (d) $\text{Fe}^{2+} > \text{Co}^{2+} > \text{Ni}^{2+} > \text{Cu}^{2+}$ (unpaired electrons)
49. The heat of hydration of Ca^{2+} , Sr^{2+} and Ba^{2+} in decreasing order is
 (a) $\text{Sr}^{2+} > \text{Ba}^{2+} > \text{Ca}^{2+}$ (b) $\text{Ba}^{2+} > \text{Sr}^{2+} > \text{Ca}^{2+}$
 (c) $\text{Ca}^{2+} > \text{Ba}^{2+} > \text{Sr}^{2+}$ (d) $\text{Ca}^{2+} > \text{Sr}^{2+} > \text{Ba}^{2+}$
50. The lowest first ionization energy of the following elements is that of
 (a) Li (b) Cl (c) I (d) Cs
51. The most metallic of the following element is
 (a) Li (b) Mg (c) K (d) Ca
52. The non-metallic cation is in
 (a) PCl_3 (b) VOCl (c) NH_4Cl (d) CrO_2Cl_2
53. Which set has all the coloured ions?
 (a) Na^+ , Mg^{2+} , Al^{3+} (b) Cu^+ , Cu^{2+} , F^- (c) Cu^{2+} , Fe^{2+} , Co^{2+} (d) Cu^{2+} , Co^{2+} , Sc^{3+}
54. The metal which gives no amphoteric oxide is
 (a) Al (b) Cu (c) Zn (d) Sn
55. Stability order of group IIIA (boron family) element is
 (a) $\text{Ga}^{3+} > \text{Ga}^+$ (b) $\text{Ga}^+ < \text{In}^+ < \text{Tl}^+$ (c) Both (a) and (b) (d) None of these
56. Following graph shows variation of ionization potential (IP) with atomic number in second period (Li – Ne). Value of ionization potential (IP) of Na(11) will be



- (a) below Li (b) above Ne
 (c) between N and O (d) below Ne and above O
57. The element which does not exist in liquid state at room temperature are
 (a) Na (b) Ga (c) Br (d) Hg
58. The factors that influence the ionization energies are
 (a) the size of the atom
 (b) the charge on the nucleus

- (c) how effectively the inner electron shell screen the nuclear charge
(d) All of the above
59. The size of the second and third row transition elements being almost the same. This is due to
(a) d-and f-orbitals do not shield the nuclear charge very effectively
(b) lanthanide contraction
(c) Both (a) and (b) are true
(d) None of the above is true
60. Size of cation is smaller than that of the atom because of
(a) gain of electrons
(b) effective nuclear charge increases
(c) the whole of the outer shell of electrons is removed
(d) statement, that cation is smaller than atom, is wrong
61. Going down in a group F to I, which of the following properties increases?
(a) Ionic radius (b) Electronegativity (c) Ionization energy (d) Oxidising power
62. (A), (B), (C) are elements in the third short period. Oxide of (A) is ionic, that of (B) is amphoteric and of (C) a giant molecule. (A), (B) and (C) will have atomic number in the order
(a) (A) < (B) < (C) (b) (C) < (B) < (A) (c) (B) < (C) < (A) (d) (C) < (A) < (B)
63. The electronegativities of N, C, Si and P are such that
(a) $\text{Si} < \text{P} < \text{C} < \text{N}$ (b) $\text{N} < \text{C} < \text{P} < \text{Si}$
(c) $\text{C} < \text{N} < \text{P} < \text{Si}$ (d) $\text{P} < \text{N} < \text{Si} < \text{C}$
64. Which is correct order of size of O^- , O^{2-} , F^- and F?
(a) $\text{O}^{2-} > \text{O}^- > \text{F}^- > \text{F}$ (b) $\text{F} > \text{F}^- > \text{O}^- > \text{O}^{2-}$
(c) $\text{O}^- > \text{O}^{2-} > \text{F} > \text{F}^-$ (d) $\text{F}^- > \text{F} > \text{O}^- > \text{O}^{2-}$
65. Which is/are amphoteric oxides?
(a) BeO (b) ZnO (c) SnO (d) All of these
66. Melting point of NaCl, NaBr, NaI and NaF will be order
(a) $\text{NaCl} > \text{NaI} < \text{NaF} < \text{NaBr}$ (b) $\text{NaBr} < \text{NaF} < \text{NaCl} < \text{NaI}$
(c) $\text{NaI} < \text{NaBr} < \text{NaCl} < \text{NaF}$ (d) $\text{NaF} < \text{NaCl} < \text{NaBr} < \text{NaI}$
67. Catenation properties of C, Si, Ge, Sn and Pb are in order
(a) $\text{C} > \text{Si} > \text{Ge} \approx \text{Sn} > \text{Pb}$ (b) $\text{C} > \text{Si} > \text{Sn} > \text{Ge} > \text{Pb}$
(c) $\text{C} < \text{Si} < \text{Ge} < \text{Sn} < \text{Pb}$ (d) None of the above
68. Stability of ions of Ge, Sn and Pb will be in order
(a) $\text{Sn}^{4+} > \text{Sn}^{2+}$ (b) $\text{Ge}^{2+} < \text{Sn}^{2+} < \text{Pb}^{2+}$
(c) $\text{Ge}^{4+} > \text{Sn}^{4+} > \text{Pb}^{4+}$ (d) All are correct
69. Inert pair effect is shown by
(a) s-block (b) p-block (c) d-block (d) f-block

70. Which pair is different from the others?
 (a) Li-Na (b) Li-Mg (c) B-Si (d) Be-Al
71. Which pair is different from the others?
 (a) Li-Mg (b) Na-K (c) B-Al (d) Ca-Mg
72. Which of the following anions is most easily polarized?
 (a) Cl^- (b) Br^- (c) Se^{2-} (d) Te^{2-}
73. Which of the following ions has the largest heat of hydration?
 (a) F^- (b) Na^+ (c) Al^{3+} (d) Sr^{2+}
74. For which of the following crystals would you expect the assumption of anion-anion contact to be valid?
 (a) KCl (b) NaF (c) NaI (d) CsBr
75. In which of the following five anions are arranged in order of decreasing ionic radius
 (a) I^- , Se^{2-} , O^{2-} , Br^- , F^- (b) I^- , Se^{2-} , Br^- , O^{2-} , F^-
 (c) Se^{2-} , I^- , Br^- , F^- , O^{2-} (d) Se^{2-} , I^- , Br^- , O^{2-} , F^-
76. Which of the following ions has the smallest radius?
 (a) Na^{2+} (b) Ti^{2+} (c) Pt^{2+} (d) Zr^{2+}
77. Which has maximum polarising power in action?
 (a) Li^+ (b) Mg^{2+} (c) Al^{3+} (d) O^{2-}





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ANSWERS

- | | | |
|---------|---------|---------|
| 1. (d) | 28. (a) | 55. (c) |
| 2. (a) | 29. (b) | 56. (a) |
| 3. (b) | 30. (c) | 57. (a) |
| 4. (c) | 31. (a) | 58. (d) |
| 5. (b) | 32. (d) | 59. (c) |
| 6. (d) | 33. (c) | 60. (b) |
| 7. (d) | 34. (b) | 61. (a) |
| 8. (c) | 35. (c) | 62. (a) |
| 9. (a) | 36. (c) | 63. (a) |
| 10. (a) | 37. (d) | 64. (a) |
| 11. (d) | 38. (d) | 65. (d) |
| 12. (b) | 39. (a) | 66. (c) |
| 13. (a) | 40. (c) | 67. (a) |
| 14. (d) | 41. (b) | 68. (d) |
| 15. (a) | 42. (b) | 69. (b) |
| 16. (b) | 43. (a) | 70. (a) |
| 17. (c) | 44. (d) | 71. (a) |
| 18. (d) | 45. (a) | 72. (d) |
| 19. (c) | 46. (b) | 73. (d) |
| 20. (d) | 47. (d) | 74. (c) |
| 21. (d) | 48. (b) | 75. (b) |
| 22. (a) | 49. (d) | 76. (a) |
| 23. (b) | 50. (d) | 77. (c) |
| 24. (b) | 51. (c) | |
| 25. (a) | 52. (c) | |
| 26. (c) | 53. (c) | |
| 27. (b) | 54. (b) | |



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Hints & Solutions

1. d

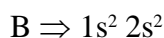
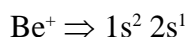
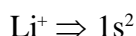
Sol. Hence, most stable oxidation state of the element is + 2.

2. a

Sol. s-orbitals are most close to the nucleus considering (ns, np, nd and nf orbitals) hence more hold of nucleus on e^- present in s-orbital therefore, more ionization energy.

3. b

Sol. After 1st ionization



4. c

Sol. $\text{Mn} \Rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$

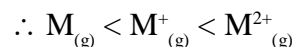
After removal of $2e^-$ from 4s orbital, Mn attains exactly half filled d-configuration. Which is stable & hence require energy among the above to remove e^- in third ionization process.

5. b

Sol. As the first electron is lost from an atom, number of e^- ↓ses and number of protons in the atom remains same so the cation experiences increased nuclear charge hence more energy is required to remove e^- from cation.

6. d

Sol. More the positive charge on atom, more will be the nuclear attraction experienced hence more ionization energy.



7. d

Sol. After removal of 1st electrons the configuration $1s^2 2s^2 2p^6 3s^2$ will be $1s^2 2s^2 2p^6 3s^1$ and it will readily lose this one more e^- . Another e^- is to be removed from noble gas configuration, large amount of energy is required.

8. c

Sol. $\text{Mg} = 1s^2 2s^2 2p^6 3s^2$

3rd e^- is to be removed from 2p – subshell

Be = $1s^2 2s^2$, 3rd e^- is to be removed from 1s – subshell

$IE_3(\text{Be})$ is almost twice of $IE_3(\text{Mg})$.

9. a

Sol. Although P has exactly has filled configuration but IE. of immediate neighbours only)

\therefore Correct order is $\Rightarrow \text{Cl} > \text{P} > \text{S}$

10. a

Sol. According to Mulliken

If IE and EA are high, the element is likely to acquire e^- rather than lose e^- when it is a part of compound and hence classified as highly electronegative.

11. d

Sol. Mulliken electronegativity values –

\Rightarrow absolute values

$\Rightarrow \chi_M = 2.8 \chi_P$

12. b

Sol. N has very low EA because there is a high e^- repulsion when the incoming e^- enters an orbital that is already half full compact 2p subshell.

13. a

Sol. 2nd EGE is always (+)ve because adding an extra electron to an already negatively charged species requires energy.

14. d

Sol. Second EGE is always (+)ve and O being small in size than S would require more energy for accomodating 2nd incoming e^- .

15. a

Sol. Ne \Rightarrow noble gas configuration $\Rightarrow 1s^2 2s^2 2p^6$

Be \Rightarrow pseudo noble gas configuration $\Rightarrow 1s^2 2s^2$

Li $\Rightarrow 1s^2 2s^1 \Rightarrow$ easily accept electron.

$\therefore \text{Ne} < \text{Be} < \text{Li} \Rightarrow \text{EA order}$

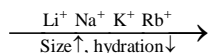
16. b

Sol. Oxygen's configuration after loss of one election will be ($1s^2 2s^2 2p^3$) i.e. exactly half filled hence it would be difficult to remove 2nd electron from a stable configuration hence more energy is required.

17. c

Sol. Extent of hydration $\propto \frac{1}{\text{size}}$

Li^+ being smallest in size have maximum charge density so it will be most hydrated.



18. d

Sol. Ga has only one electron in its valence shell so it lose that electron easily to obtain fully filled

subshells. Therefore least energy is required to ionize Ga among the following.

19. c

Sol. According to Fajan's rule, smaller the size of cation, more will be its polarizing power.

20. d

Sol. $O_{(g)}^{2-} \leftarrow O_{(g)}^{-} + e^{-}$

this is an endothermic process because adding electron to an already negatively charged species requires energy because of increased inter electronic repulsions.

21. d

Sol. Z for Li \Rightarrow 3 and third e^{-} is to be removed from 1s-subshell

$$\therefore IE = \frac{13.6Z^2}{n^2} = \frac{13.6 \times (3)^2}{(1)^2} = 13.6 \times 9 \text{ eV}$$

22. a

Sol. Greater the (+)ve charge, smaller is the size
Smaller greater the (-)ve charge, larger is the size

23. b

Sol. Only 1st step (I) is endothermic because ionization is taking place II & III are exothermic processes.

24. b

Sol. According to Aufbau's principle and $(n + l)$ rule –
Energy order of $\Rightarrow 6s < 4f < 5d$

$\left. \begin{array}{l} \bullet 4s, 3d, 4p \\ \bullet 6s, 4f, 5d \\ \bullet 4p, 5s, 4d \\ \bullet 3s, 3p, 3d \end{array} \right\} \begin{array}{l} \text{correct} \\ \text{sequencing} \end{array}$

25. a

Sol. Pauling recognized that polar bonds have higher bond energies than non-polar bonds formed from same elements.

Pauling introduced the concept of electronegativity as the means of describing bond energies.

26. (c)

Sol. $Zn \ 1s^2 \mid 2s^2 \ 2p^6 \mid 3s^2 \ 3p^6 \ 3d^{10} \mid 4s^2$

σ for 1s electron (inner most electron) $= 1 \times 0.30 = 0.30$

$Z^* = Z - \sigma = 30 - 0.30 = 29.70$

27. b

Sol. After removal of $1e^{-}$, Se attains exactly half filled configuration to have lowest first ionization energy.

28. a

Sol. Smaller the size of cation, more will be charge density, greater is degree of hydration.

29. b

Sol. On going from left to right across a period, electronegativity increases.

30. c

Sol. More the (+)ve charge, smaller is the size, more (–)ve charge greater size.

Size $\Rightarrow \text{O}^{2-} > \text{Me} > \text{Mg}^{2+}$

31. (a)

Sol. The dominant factor in determining the IE of elements on moving down the group is atomic radius. IE strongly correlate with atomic radii.

Correct answer is (a)

Sol. (d)

32. Helium being a noble gas with electronic configuration $1s^2$. But He^+ has only one e^- in its $1s$ -subshell so it will be experiencing a very high nuclear charge hence IE than He.

Correct answer is (d)

33. (c)

Sol. Mg^{2+} has fully filled electronic configuration which is like noble gas so it will have highest IE.

Correct option is (c)

34. (b)

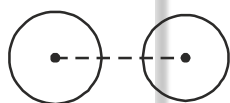
Sol. SI unit of IE is kJ/mol

Correct option is (b)

35. (c)

Sol. $r_{\text{VW}} > r_{\text{MR}} > r_{\text{CR}}$

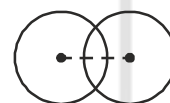
VW \rightarrow Vander waal radii, MR \rightarrow Metallic radii, CR \rightarrow covalent radii



Vander waal radius



Metallic radius



Covalent radius

Strength of bond –

Covalent bond $>$ metallic bond $>$ vander waal interaction

Correct option is (c)

36. (c)

Sol. • Bond length is shortened when electronegativities are different. For e.g.

$\text{C} - \text{C} \Rightarrow 164 \text{ pm}$ and $\text{C} - \text{O} \Rightarrow 151 \text{ pm}$

• When multiplicity occurs b/w atoms then also bond lengths are shortened.

Correct option is (c)

37 (d)

Sol. Down the group atomic radius increases and across a period, it decreases.

Correct option is (d)

38. (d)
Sol. Screening/shielding is a polyelectronic phenomenon and all the given species are monelectronic. Hence no screening effect is observed in any of these.
Correct option is (d)
39. (a)
Sol. The relative extent of penetrating effect $\Rightarrow s > p > d > f$ s-orbitals lying closest to nucleus and f lies at far distance from nucleus
Correct option is (a)
40. (c)
Sol. Actinides are analogous to the lanthanides.
Correct option is (c)
41. (b)
Sol. B and Si are metalloids
Correct option is (b)
42. (b)
Sol. Since outer electronic configuration of atomic no. 113 and 115 is $7s^2 7p^1$ and $7s^2 7p^3$ respectively. So valence e^- are in p-orbital.
Correct option is (b)
43. (a)
Sol. Outer configuration of atomic no. 113 is $7s^2 7p^1$. So, most stable cation will be M^+ .
Correct option is (a)
44. (d)
Sol. Numbering of groups as 1, 2, 18 was adopted by IUPAC in 1988.
Correct option is (d)
45. (a)
Sol. $^{115}\text{X} \longrightarrow ^{113}\text{Y} + {}^4_2\text{He}$
Element 113 is produced via α -decay of element 115.
Correct option is (a)
46. (b)
Sol. In August 2003, elements with atomic no. 113 and 115 were discovered
Correct option is (b)
47. (d)
Sol. Element with atomic no. 110 has been named as Ds by IUPAC.
Correct option is (d)

48. (b)

Sol. The correct of size is: $\text{Cr}^{2+} > \text{Fe}^{2+} > \text{Ni}^{2+} > \text{Mn}^{2+}$

Correct option is (b)

49. (d)

Sol. Heat of hydration $\propto \frac{1}{\text{Size}}$, $\xrightarrow[\text{Size} \uparrow]{\text{Ca}^{2+} < \text{Sr}^{2+} < \text{Ba}^{2+}}$, heat of hydration order $\Rightarrow \text{Ca}^{2+} > \text{Sr}^{2+} > \text{Ba}^{2+}$

Correct option is (d)

50. (d)

Sol. Caesium being alkali metal and larger in size hence have lowest ionization energy.

Correct option is (d)

51. (c)

Sol. The metallic character of elements decrease across a period and increase down the group.

\therefore K will have highest metallic character among the following.

Correct option is (c)

52. (c)

Sol. The non-metallic cation is present in NH_4Cl i.e. NH_4^+ .

Correct option is (c)

53. (c)

Sol. Cu^{2+} , Fe^{2+} , Co^{2+} , all the ions are coloured.

Correct option is (c)

54. (b)

Sol. Cu do not give amphoteric oxides.

Correct option is (b)

55. (c)

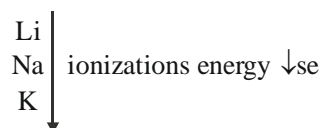
Sol. In p-block elements, on descending the group, stability of oxidation state 2 less than the group oxidation state increases due to inert pair effect.

So, $\text{Ga}^{3+} > \text{Ga}^+$ and $\text{Ga}^{+1} < \text{In}^{+1} < \text{Tl}^{+1}$

Correct option is (c)

56. (a)

Sol. Down the group, ionization energy decreases.



\therefore IE of Na will be below Li

Correct option is (a)

57. (a)

Sol. Na is not liquid at room temperature.

Correct option is (a)

58. (d)

Sol. Ionization energies are influenced by–

- size of atom
- charge on nucleus
- how effectively the inner e^- screen the nuclear charge

Correct option is (d)

59. (c)

Sol. The size of 2nd & 3rd row transition elements is almost similar because d and f-orbitals do not shield the nuclear charge effectively and this contraction in size of 3rd row transition metals is known as lanthanide contraction.

Correct option is (c)

60. (b)

Sol. Size of cation is smaller than that of atom because effective nuclear charge increases as no. of electrons are less in cation and nuclear charge remains the same. So, hold of nucleus on e^- increases.

Correct option is (b)

61. (a)

Sol. On going from F to I, ionic radius increases.

Correct option is (a)

62. (a)

Sol. Third short period elements are–

Na, Mg, Al, Si, P, S, Cl and Ar.

A forms ionic oxide \Rightarrow (Na/Mg)

B is amphoteric \Rightarrow (Al)

C is large in size \Rightarrow (Ar)

So, atomic no. $C > B > A$

Correct option is (a)

63. (a)

Sol. There is a general increase in electronegativity across a period and decrease in electronegativity down the group.

\therefore EN order : $Si < P < C < N$

Correct option is (a)

64. (a)
Sol. More the anionic charge larger is the size. And across a period (from left to right) size decreases.
$$\text{O}^{2-} > \text{O}^{-} > \text{F}^{-} > \text{F}$$

Correct option is (a)
65. (d)
Sol. Zn, Al, Be, Ga, Pb, Sn, As, Sb, Bi, In, Ge. These elements forms amphoteric oxides.
Correct option is (d)
66. (c)
Sol. High lattice energy will lead to high melting point. NaF having highest lattice energy will have highest melting point.
 $\text{NaF} > \text{NaCl} > \text{NaBr} > \text{NaI} \Rightarrow$ order of melting point
Correct option is (c)
67. (a)
Sol. The catenation property order–
 $\text{C} > \text{Si} > \text{Ge} \approx \text{Sn} > \text{Pb}$
Correct option is (a)
68. (d)
Sol. Down the group in p-block elements, heavier elements are much stable in oxidation state 2 less than the group oxidation state. This is known as inert pair effect.
Correct option is (d)
69. (b)
Sol. Inert pair effect is shown by p-block elements.
Correct option is (b)
70. (a)
Sol. Li-Na is different because all others show diagonal relationship.
Correct option is (a)
71. (a)
Sol. Li-Mg shows diagonal relationship while all other elements pairs belongs to same group.
Correct option is (a)
72. (d)
Sol. Larger the size of anion, more easy it will be to distort the electron cloud i.e. more easily polarizable. Te^{2-} is most easily polarized.
Correct option is (d)
73. (d)
Sol. Smaller the size of cation, larger will be the heat of hydration. Al^{3+} has highest heat of hydration.
Correct option is (d)

74. (c)

Sol. Since size of cation is very small in comparison to the anion. Hence, in NaI crystal the assumption of anion-anion contact is valid.

Correct option is (c)

75. (b)

Sol. Down the group size of element increases while on going from left to right in a period, size of element decreases.

Since the given species are not isoelectronic the correct order of ionic radii is-



O	F
S	Cl
Se	Br
Te	I

Correct option is (b)

76. (a)

Sol. Among the following Na^{2+} is having smallest radius.

Correct option is (a)

77. (c)

Sol. Polarizing power $\propto \frac{1}{\text{Size of cation}}$

Al^{3+} have highest polarising power among the following.

Correct option is (c)

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